Geophysical Research Abstracts,
Vol. 10, EGU2008-A-07575, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-07575
EGU General Assembly 2008

Transient simulations over the EPICA record using GENIE-1

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We present transient simulations of the last 650,000 years using GENIE-1, an Intermediate Complexity ESM with coupled 3D-Ocean, EMBM atmosphere and a single-PFT model of vegetation. The simulations are forced with Vostok/EPICA CO_2. Ice sheets and the associated freshwater forcing are derived from Peltier 4G, interpolated backward using the δ^{18}O benthic stack record of Lisiecki and Raymo (2005). The simulations are a precursor to fully coupled modelling with a closed carbon cycle including ocean biogeochemistry.

The simulated Antarctic temperature anomaly correlates closely with the deuterium-inferred anomaly and the magnitude of g-ig variation is well reproduced. In view of the more comprehensive forcing and dynamics, this result has implications beyond the correlative results of the EPICA challenge exercise.

During the early phase of glaciation, the build up of ice sheets and the drawdown of CO_2 act together to produce the rapid cooling observed. In each phase, the initial interglacial is typically followed, approximately 40,000 years later, by a secondary warming. Prior to MIS11 this secondary warming is stronger than the initial warming and is manifested through longer, though weaker, interglacials; a similar effect is observed in MIS7. As ice sheets approach their maximum areal extent, further, more gradual temperature falls are principally associated with continued CO_2 drawdown; the simulations suggest that CO_2 variations are the dominant driver of Antarctic temperature change. As expected, all terminations are very rapid; substantial freshwater forcing at terminations generally leads to a partial shutdown of the AMOC, leading to

YD-like cooling events in Greenland.